European journal of volunteering and community-based projects Vol.1, No 4; 2022
ISSN: 2724-0592 E-ISSN: 2724-1947
Published by Odv Casa Arcobaleno

An evaluation of the frequency of cyanotic & acyanotic CHDs in children of Faisalabad

Abdul Maajid Khokhar

Faculty of Medical Sciences, Department of Allied Health Sciences Radiography and Imaging Technology, Government College University Faisalabad, Pakistan

Muhammad Mohsin Ali

Faculty of Medical Sciences, Department of Physical therapy, Government College University Faisalabad, Pakistan

Muhammad Waqar Tahir

Faculty of Medical Sciences, Department of Physical therapy, Government College University Faisalabad, Pakistan

Rimsha Ali

Faculty of Medical Sciences, Department of Physical therapy, Government College University Faisalabad, Pakistan

Abstract:

Aim: The research paper aims to analyze the frequency of Cyanotic and Acyanotic Congenital Heart Defects (CHDs) in children up to 2 years of age in Faisalabad, Pakistan and the secondary aim is to see the gold standard modality for the diagnosis of CHDs.

Method: A cross-sectional study was performed via consecutive sampling based on 120 questionnaires conducted at the Faisalabad Institute of Cardiology. The data was collected with the permission of the relevant department and with the consent of the patient.

Results: Data from 120 patients were collected with a 60% male to 40% female ratio. Out of 120 referred children (neonates; 29.9%, less than 1 year; 50.2%, greater than 1 year; 19.9%), 93% were diagnosed as having congenital heart defects. The relative frequencies of cyanotic and acyanotic congenital heart defects were 17% and 83%. The majority of patients with congenital heart disease detected have acyanotic congenital heart defects.

Conclusion: Tetralogy of Fallot is the commonest cyanotic defect while Ventricular Septal Defect is the commonest acyanotic defect. To prevent complications, early detection of heart failure is very important for proper management. The 2D-echo with the Doppler test creates a gold standard for diagnosis.

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Keywords: Congenital heart defects, echocardiography, frequency of CHDs, cyanotic heart defects, acyanotic heart defects.

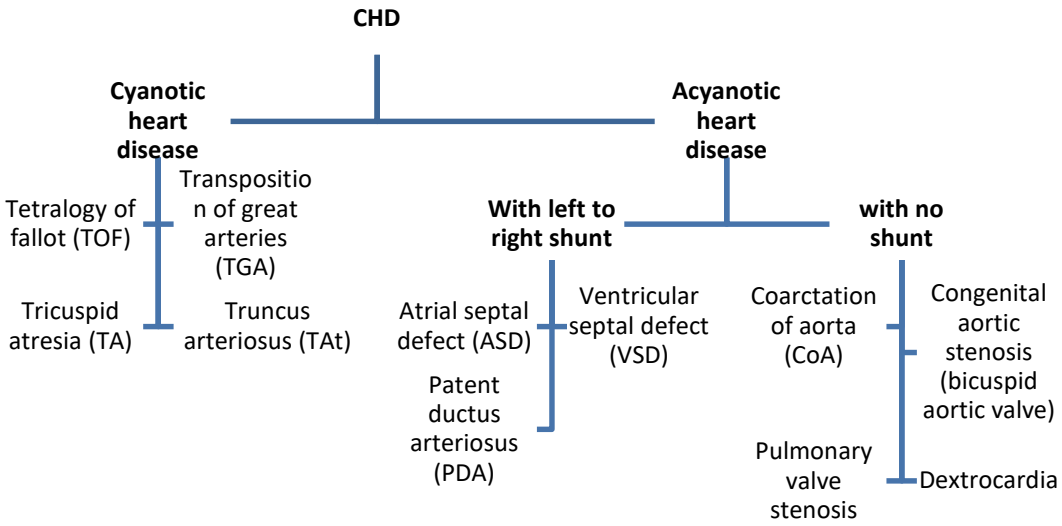
Doi: 10.5281/zenodo.7527533

1.Introduction

Congenital heart diseases, also known as congenital cardiovascular defects, are structural problems that arise from abnormal formation of the heart or major blood vessels of significant potential during fetal development (Hoffman & Kaplan, 2002; Saleh, 2009). CHDs are the most common congenital fetal malformations accounting for nearly 25% of all congenital malformations and are responsible for a high rate of child mortality and morbidity (Amro, 2009). CHDs may present at different ages from birth to adolescent age groups. It is estimated that two-thirds of affected patients are critical in the first year of life, and only a few of them can reach childhood either by natural selection or by successful management or curative surgery (Saleh, 2009). Most cases are asymptomatic and discovered during routine checkups. Other presentations can range from cyanosis and clubbing of fingers to full congestive heart failure. Its etiology is unknown, but it seems to be multifactorial and involves chromosomal abnormality, maternal diabetes, smoking, teratogenic drug, maternal infection during early pregnancy, and environmental factors (Amro, 2009). Congenital heart disease is an important cause of infant death in developed and undeveloped countries. In developed countries, the number of babies born with CHD has been reduced after timely therapeutic abortion, and survival has improved after surgical correction (Khalil, Aggarwal, Thirupuram, & Arora, 1994). Contrary, in undeveloped countries where health services are insufficient or accessible only to wealthy people, the vast majority of patients die or are left undiagnosed. From the beginning, new technologies worked for the continuation of children's hearts (Moons et al., 2009). The introduction of echocardiography into a standard diagnostic procedure is one of the most dramatic changes in its development because it provided a symbolic recording of cardiac action and an understanding of the flow and hemodynamic effects carried by certain organizations (Miranović, 2014).

The heart is a muscular organ pyramidal in shape and lies obliquely in the chest (Ryan, McNicholas, & Eustace, 2011). It weighs between 250-350g (Snell, 1995). It acts as a pumping organ that supplies blood to the body and receives venous blood in return for gas exchange (Snell, 1995). The heart contains four chambers which are two atria and two ventricles. Its square-shaped base points to the rear and the horizontal peak to the left and bottom. The left

atrium forms the base or posterior segment, with the upper and lower pulmonary arteries extending to its four corners (Ryan et al., 2011). The right atrium forms the right border, and the superior and inferior vena cava draws in its upper and lower extremities (Snell, 1995). The upper extremity and the left border are formed by the left ventricle. The right ventricle forms the anterior part. The lower heart (diaphragmatic) is made up of both the front ventricles and the small part of the right atrium at the back where the IVC enters the chamber (Ryan et al., 2011; Snell, 1995). The oblique shape of the heart causes the ventricles to lie flat outside and under the atria. The septa of internal communication systems are said to be lying on the left plane of the interior (Snell, 1995). The tricuspid and mitral valves, which separate the right and left atria and ventricles respectively, are almost vertical. The valve plane is also tilted downwards and to the left (Ryan et al., 2011).



Hierarchical representation of types of congenital heart disease (Danish, 2015).

The study conducted by Saleh, H.K., 2005 on the pattern of congenital heart disease in southern Yemeni children referred to echocardiography. The retrospective study was performed on echocardiographic findings of 393 symptomatic children affected by congenital heart disease, 48 % males and 52% females. According to this study, the most frequent defects were VSD (26.5%), pulmonary stenosis (17.6%), PDA (17.3%), ASD (15.8%), TOF (8.9%), and TGA (3.1%) (Saleh, 2009).

The study conducted by Awori *et al.,* 2013 on the spectrum of pediatric congenital heart disease at the Kenyatta national hospital Naibori. The retrospective study was performed on the echocardiographic findings of 214 patients with a mean age of 18.6 months. According to this study the frequencies of congenital heart defects were VSD (18.7%), ASD (4.7%), TOF

(10.7%), TGA (8.4%), C-AVCD (6.5%), PDA (10.7%), TA (4.2%), CoA (0.9%), and others (39.2%) (Awori, 2013).

Objective: The objective of this study is to analyze the frequency of congenital heart defects in children of age up to 2 years in Faisalabad, Pakistan.

Aim: This study aims to find the most frequent congenital heart defect in children up to 2 years of age that are referred for echocardiography at the Faisalabad Institute of Cardiology (FIC), Pakistan.

Rationale: To prevent CHD complications by early diagnosis of heart in referred patients by the gold standard modality (2D echocardiography with Doppler).

Terms	Operational definitions	References
Ventricular septal defect (VSD)	The breach in the continuity of the IVS creates communication between the left and right ventricles. The flow of blood from the left ventricle (high pressure) to the right ventricle (lower pressure) constitutes a left-to-right shunt across the ventricular septal defect.	(Kaddoura, 2016)
Atrial septal defect (ASD)	The breach in the continuity of the IAS creates the communication between the left to right atria. The flow of blood from the left atrium (high pressure) to the right atrium (lower pressure) constitutes a left-to-right shunt across the atrial septal defect.	(Kaddoura, 2016)
Patent ductus arteriosus (PDA)	The ductus arteriosus fails to close after birth and thus provides communication between the aorta and the pulmonary artery. The flow of blood from the aorta (high pressure) to the pulmonary artery (lower pressure) constitutes a left-to-right shunt across the patent ductus arteriosus.	(Kaddoura, 2016)
Coarctation of the aorta (CoA)	Congenital narrowing of the aorta at or just distal to the region where ductus arteriosus joins the aorta impedes the flow of blood below the level of the constriction and increases blood pressure above the constriction	(Kaddoura, 2016)
Tetralogy of Fallot (TOF)	Characterized by VSD usually per membranous, overriding of aorta, RVOTO & RV hypertrophy.	(Danish, 2015)
Transposition of great arteries (TGA):	This is the malformation in which the aorta originates from the morphologically right ventricle while the pulmonary artery from the morphologically left ventricle.	(Kaddoura, 2016)

Tricuspid atresia (TA):	Congenital absence or agenesis of the tricuspid valve. Tricuspid atresia is the most common cause of cyanosis with left ventricular hypertrophy.	(Danish, 2015)
Truncus arteriosus (TAt):	Uncommon congenital cardiovascular anomaly in which a single common blood vessel comes out of the heart, instead of the usual two vessels (main pulmonary artery and aorta). Occurs when the arteries out of the heart in a developing child fail to completely separate during adulthood, leaving connections between the aorta and pulmonary artery.	(Kaddoura, 2016)
Ebstein anomaly	Characterized by the apical migration of the septal valve and posterior tricuspid valves, resulting in the flexion of the right ventricle with a variable degree of resistance to the migration of the internal tract**.**	(Kaddoura, 2016)
Pulmonary valve stenosis (PVS):	Disorder in which the outflow of blood from the right ventricle of the heart is obstructed at the level of the pulmonic valve. This results in the reduction of the flow of blood to the lungs.	(Kaddoura, 2016)
Atrioventricular septal defect (AVSD)	AVCD, formerly known as the "common atrioventricular canal" (CAVC) or "endocardial cushion defect", is characterized by a deficiency of the atrioventricular heart septum. It is caused by abnormal or insufficient connections of the upper and lower endocardial cushions to the middle part of the atrial septum and part of the ventricular septum muscles.	(Kaddoura, 2016)

2.Materials and method

Study design and setting: This is a descriptive (cross-sectional) study that started from January 2020 to March 2020, a total of 3 months focusing on the evaluation of the frequency of cyanotic and acyanotic CHDs conducted at the Faisalabad Institute of Cardiology (FIC).

Sample size and data collection: A total of 120 patients were selected at the FIC. Data was collected by Performa via a consecutive sampling technique.

Inclusion Criteria: All patients (males and females) up to 2 years of age referred to the Cardiology department for echocardiography.

Exclusion Criteria: All patients above 2 years of age presented to the cardiology department for echocardiography.

Data Analysis and presentation: The data of 120 patients were entered and analyzed by using the Statistical Package for the Social Sciences (SPSS) software computer program version 20. Data was presented in tables, graphs, or pie diagrams.

2.1Ethical Consideration:

- Confidentiality of information was ensured.
- There is no ethical issue regarding the topic of study as the study was completely observational.
- The study was duly approved by the ethical committee of Faisal Hospital (FIHS) Faisalabad.

3.Results

To evaluate the frequency of congenital heart defects in infants and young children. Data from 120 children were evaluated. There were 60% males (n=72) and 40% females (n=48). Informed consent was obtained from each patient before inclusion in the study. Echocardiographic data were collected on a predesigned Performa. Out of 120 referred children (neonates: 29.9%, less than 1 year: 50.2%, greater than 1 year: 19.9%) 93% were diagnosed as having congenital heart defects.

The relative frequencies of cyanotic and acyanotic congenital heart defects were 17% and 83% (Figure 3.1). Ventricular Septal Defect (33.3%) followed by the Atrial Septal Defect (10.8%) and Patent Ductus Arteriosus (22.5%) were the commonest acyanotic congenital heart defects. Whereas, Tetralogy of Fallot (6.6%) followed by Transposition of Great Vessels (5.8%) and Tricuspid Atresia (2.5%) were the commonest cyanotic congenital heart defects. The relative frequencies of congenital heart defects are shown in table 3.1.

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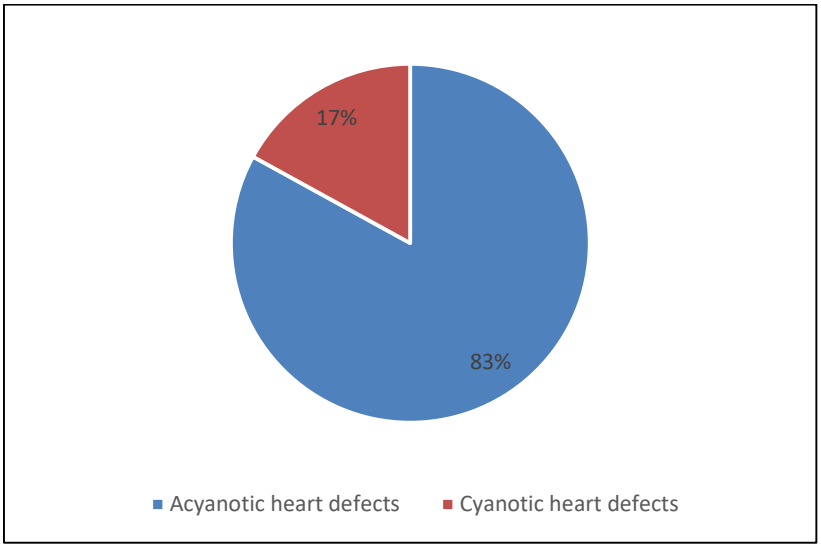

Figure 3.1: Pie chart representing the relative percentages of cyanotic and acyanotic heart defects.

Table 3.1: The relative frequencies of congenital heart defects in infants and young children.

Disease	Frequency(n)	%
Atrial Septal Defect	13	10.8
Ventricular Septal Defect	40	33.3
Patent Ductus Arteriosus	27	22.5
Coarctation of Aorta	5	4.1
Tetralogy of Fallot	8	6.6
Transposition of great Arteries	7	5.8
Tricuspid Atresia	3	2.5
Ebstein's Anomaly	3	2.5
Truncus Arteriosus	3	2.5
Pulmonary valve stenosis	6	5
C-AVSD	2	1.6
OTHERS	3	2.5

Others**:** DORV, DC, hypotrophied IVS, PH, MR, MS, AR, and AS

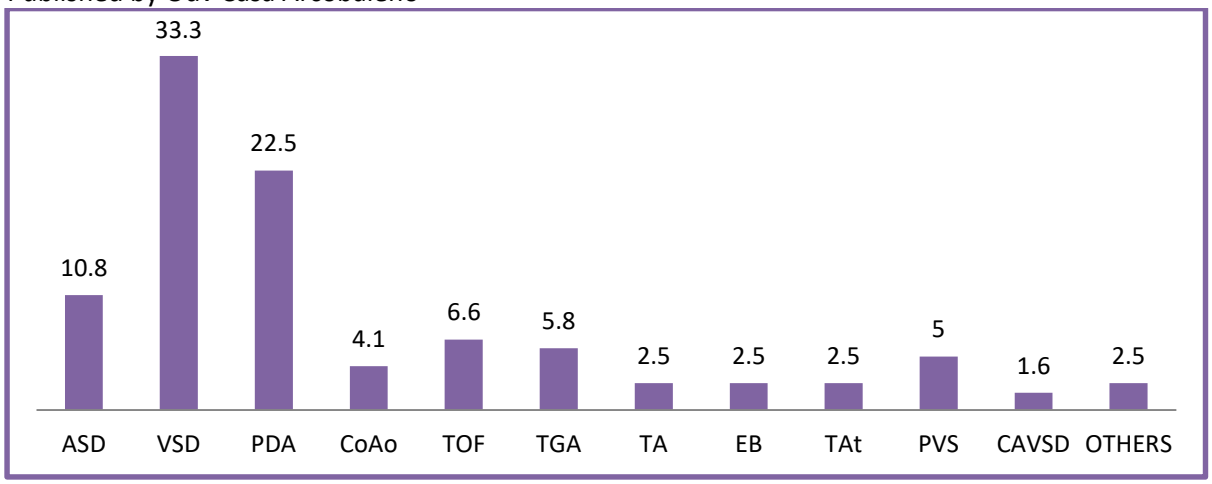

Figure 3.2: Simple bar chart representing the most frequent congenital heart defects in infants and young children. (Others**:** DORV, DC, Hypotrophied IVS, PH, MR, MS, AR, and AS)

4.Discussion

The current study found that acyanotic congenital heart diseases were more common than cyanotic CHDs. The relative frequencies of cyanotic CHDs and acyanotic CHDs were 17%, and 83% respectively. This is well correlated with other studies. The relative frequencies of most frequent acyanotic diseases were VSD 33.3%, PDA 22.5%, and ASD 10.8%. The relative frequencies of most frequent cyanotic diseases were TOF 6.6%, TGA 5.9%, and TA 2.5%.

Ventricular septal defect (VSD) with an incidence of 33.3% was the most common acyanotic defect in our study. Similar to the results of other studies conducted in Belgium (Amro, 2009). That incidence was lower than the incidence reported at 48.4% in Jordan (Amro, 2009). That incidence was higher than the incidence reported at 22.8% in Turkey (Gol, Dehdilani, Montazer, & Hashemzadeh). Factors such as the gold standard of the diagnosis, the delay in diagnosis of VSDs allowed more VSDs to close spontaneously, the non-recognition of minimum or small septal defects by the physician responsible for primary care, and the limited time of my study may have contributed to the differences between our figures and those in literature.

Patent ductus arteriosus (PDA) is another common defect that has an increased incidence among preterm infants. In the current study, 22.3% of children had PDA which was the second most common acyanotic defect observed in children's hospital. Similar other studies were conducted in Turkey (Gol et al.), Yemen (Saleh, 2009), and Jordan (Amro, 2009) resulting in

frequencies of PDA of 17.1%, 17.3%, and 8.3% respectively. The reason for the increase in the frequency of PDA may be due to the high rate of preterm deliveries.

The third most frequent acyanotic heart defect was the Atrial Septal Defect (ASD) in frequency accounting (10.7%) in our study. According to the result of other studies that were conducted in Turkey (Gol et al.), Yemen (Saleh, 2009), and Jordan (Amro, 2009) resulting frequency of ASD is 20%, 15.8%, and 13.6% respectively. The frequency of ASD is more likely to be less than in other studies performed because my study criteria was the age group up to 2 years and the fact that ASDs are asymptomatic in childhood. ASD is usually asymptomatic and has murmurs that are often soft, these defects frequently do not lead to early diagnosis. This is why many of these cases are present in adult life.

Among the cyanotic lesions Tetralogy of Fallot (TOF) was the commonest cyanotic congenital heart disease followed by transposition of the great arteries (TGA) (5.9%) and (5.4%) respectively. According to the result of other studies that were conducted in Yemen (Saleh, 2009), Jordan (Amro, 2009), and Naibori (Awori, 2013) resulting frequencies of TOF and TGA were (8.9%, 3.1%), (9.5%, 5.5%), and (10.7%, 8.4%) respectively. The results of TOF and TGA were different from other literature studies due to limited time, limited sample size, and specific inclusion criteria of my study.

5.Conclusion

In conclusion, this study gives only an overview of the pattern of congenital heart disease at the Faisalabad Institute of Cardiology (FIC). The majority of patients with congenital heart disease detected have acyanotic congenital heart defects. Tetralogy of Fallot (TOF) is the commonest cyanotic defect and Ventricular Septal Defect (VSD) is of acyanotic defect. To prevent complications, early detection of heart failure is very important for proper management. The 2D-echo with the Doppler test creates a gold standard for diagnosis.

5.1Limitations

This study was carried out on a relatively small number of patients, therefore further studies with a large number of patients are recommended. The study does not give the true incidence of CHDs in the total population as it was confined to the Faisalabad Institute of Cardiology only, this need to be done on a larger scale. There was a short time for compiling the study and performing it with limited financial resources.

5.2Suggestions:

Information about research work must be collected from different media. To prevent the incidence of CHDs; the use of folic acid in preconception period, pre-pregnancy immunization against rubella, fetal echocardiography, prenatal diagnosis, termination of pregnancy in complex cases, and hospital deliveries should be promoted. Train the health personnel to carry out routine neonatal and infant examinations including pulse oximetry and refer patients early to the cardiologist.

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European journal of volunteering and community-based projects Vol.1, No 4; 2022
ISSN: 2724-0592 E-ISSN: 2724-1947
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PERFORMA

NAME	
AGE	
GENDER	
WEIGHT	
MR#	

ECHOCARDIOGRAPHIC FINDING:	**PRESENT**	**ABSENT**
Atrial Septal Defect		
Ventricular Septal Defect		
Patent Ductus Arteriosus		
Coarctation of Aorta		
Tetralogy of Fallot		
Transposition of great Arteries		
Tricuspid Atresia		
Ebstein's Anomaly		
Truncus Arteriosus		
Pulmonary valve stenosis		
C-AVSD		

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Consent form

<table>
<tr><td colspan="2">The objective of my study is to analyze the frequency of congenital heart defects in children of age up to 2 years.</td></tr>
<tr><td colspan="2">Procedure
In this study we will do the transthoracic echocardiography of the patients to evaluate the various congenital heart diseases.</td></tr>
<tr><td>Possible risk
No risk</td><td>Financial benefit
No financial benefits for your participation in this study.</td></tr>
<tr><td colspan="2">Confidentiality
This information provided by you will be confidential.</td></tr>
<tr><td colspan="2">Available source of information
You may ask any question from my supervisor.</td></tr>
<tr><td colspan="2">Authorization
I have read and understand this consent form, and I volunteer to participate in this research study.</td></tr>
</table>

My signature below indicates my consent.

Name of participant: _____

Signature of principal investigator: _____